

# **SUPPORT STRUCTURE WITH FOLDABLE END CAP HAVING PIVOTING MECHANISM**

## **BACKGROUND OF THE INVENTION**

### **1. Field of the invention.**

The present invention is a continuation-in-part application claiming priority from relates to portable support structures for use in temporary or permanent stands or displays, such as trade shows and conventions, and particularly to a portable truss assembly having a foldable end cap connecting planar wall elements.

### **2. Description of Related Art.**

Commercial displays such as those used in trade show booths require strong structures that can be easily transported and configured in a wide variety of forms. Such structures need to be lightweight, portable, and able to be quickly set up and broken down.

Prior display structures have contained folding elements that utilize rigid wall members coupled with rotatable wall members. The rotatable wall members allow the display to collapse. The displays include other pivoting members that serve to lock the assembly into an open position. Although useful in some applications, this approach has deficiencies. The need for numerous differently configured rigid and rotatable members increases the inventory of parts, thereby making assembly more complicated and expensive. Further, the pivoting

members may not provide a significant locking force to provide sufficient structural stiffness in some applications.

It can be seen that there is a need for a collapsible/foldable truss assembly that is strong, easily fabricated and assembled into a temporary or permanent structure. The present invention fulfills these and other needs, and addresses other deficiencies of prior art implementations.

## SUMMARY OF THE INVENTION

To overcome the limitations in the prior art described above, and to overcome other limitations that will become apparent upon reading and understanding the present specification, the present invention discloses a portable support structure adapted for use in temporary or permanent stands or displays. The portable truss assembly disclosed herein has a foldable end cap that connects planar wall elements.

An apparatus in accordance with the principles of the present invention includes a foldable truss assembly including a plurality of wall members. The wall members having a first and second receiving member. Each receiving member is capable of receiving an attachment member of at least one foldable end cap. The foldable end cap including a plurality of elongated arm members. Each arm member having a first and second end. The end cap also including a plurality of end bars. Each end bar having a corner member disposed at ends thereof. The end cap also including a plurality of pivoting members. Each pivoting member pivotally connecting an arm member and an end bar. The arm members and end bars being connected by the pivoting members forming a closed loop. The end cap also including a plurality of attachment members capable of being inserted into an interior space of the corner members of the end bars. The end cap also including a fastening mechanism fixedly attaching the arm members to the end bars. The fastening mechanism providing relative rotation between an arm member and an adjacent arm member.

Other embodiments of a system in accordance with the principles of the present invention may include alternative or optional additional aspects. One such aspect of the present invention is that the fastening mechanism includes hinge brackets disposed on ends of the end bars. The hinge brackets cooperatively engaging ends of the arm members.

Another aspect of the present invention is that the fastening mechanism further includes a nut, a bolt and a plurality of washers for securing arm members to end bars and restricting relative motion of the wall members of the truss assembly.

Another aspect of the present invention is that each of the arm members also include a plurality of fastening holes and the end bars including pivot members disposed upon the corner members at ends of the end bars. The pivot members pivotally joining the arm members to the end bars.

Another aspect of the present invention is that the attachment members protrude from a side of the end cap.

Another aspect of the present invention is that the wall members include two elongated support members and a cross member fixedly connected between the support members.

Another aspect of the present invention is that the at least one end cap includes two end caps. The plurality of wall members having first and second receiving members at opposing ends of the wall members. The attachment members of one end cap being received into the receiving members on opposing

ends of the wall members and portions of the wall members being received into interior spaces of corner members of another end cap.

Another apparatus in accordance with the principles of the present invention includes a foldable truss assembly including a plurality of wall members having a first and second receiving member. Each receiving member is capable of receiving an attachment member of a foldable end cap. The foldable end cap including a plurality of elongated arm members. Each arm member having a first and second end. The end cap also including a plurality of end bars. Each end bar having a corner member disposed at ends thereof. The end cap including a plurality of swiveling mechanisms disposed on the corner members of the end bars. Each swiveling mechanism pivotally joining an end of an arm member and an end of an end bar. The arm members being connected to the end bars forming a closed loop.

Another aspect of the present invention is that each of the arm members further comprise pivot holes at the first and second ends. The swiveling mechanism passing through the pivot holes of an arm member to join the arm member to an end bar.

Another aspect of the present invention is that the wall members include two elongated support members and a cross member fixedly connected between the support members.

Another aspect of the present invention is that the at least one end cap includes two end caps, and portions of the wall members are received into interior spaces of corner members of the two end caps.

A method in accordance with the principles of the present invention includes a method of assembling a foldable truss member including unfolding at least one end cap. The end cap including a plurality of arm members and a plurality of end bars. The arm members are adjacently connected to the end bars forming a closed loop. Each arm member is pivotally connected to each adjacent end bar. The method also includes attaching a plurality of wall members to the end cap and adjusting a fastening mechanism to lock the arm members and the end bars into relative proximity.

Another aspect of the present invention is that the method also includes attaching a cross brace between diagonal corners of two of the wall members to stabilize the wall members.

Another aspect of the present invention is that the method also includes attaching a pair of bracing elements between opposing corners of two wall members to stabilize the wall members.

A method in accordance with the principles of the present invention includes a method of assembling a foldable truss member including unfolding a pair of end caps. The end caps including a plurality of arm members and a plurality of end bars. The arm members are adjacently connected to the end bars forming a closed loop. Each arm member is pivotally connected to each adjacent end bar. The method also includes attaching the end caps to opposing ends of a plurality of wall members and adjusting fastening mechanisms to lock the arm members and the end bars into relative proximity.

Another aspect of the present invention is that the method also includes attaching a cross brace between diagonal corners of the two end caps to stabilize the wall members.

Another aspect of the present invention is that the method also includes attaching a pair of bracing elements between opposing corners of the two end caps to stabilize the wall members.

Another apparatus in accordance with the principles of the present invention includes a foldable truss assembly including a plurality of wall members. The wall members are capable of receiving an attachment means of at least one foldable end cap. The foldable end cap including a plurality of elongated arm members, a plurality of end bars, and a plurality of pivot means. Each pivot means pivotally connecting an arm member and an end bar. The arm members and end bars are connected by the pivot means forming a closed loop. The end cap also including a plurality of attachment means being disposed on corner members of the end bars and a fastening means fixedly attaching the arm members to the end bars. The fastening means preventing relative rotation between an arm member and an adjacent arm member.

Another aspect of the present invention is that the fastening means includes brackets disposed on ends of the end bars. The brackets cooperatively engaging ends of the arm members.

Another aspect of the present invention is that the fastening means also include a nut, a bolt and a plurality of washers for securing arm members to end bars and restricting relative motion of the wall members of the truss assembly.

Another aspect of the present invention is that each of the arm members also include a plurality of fastening holes for joining the arm members to the end bars.

Another aspect of the present invention is that the attachment means protrude from a side of the end cap:

Another aspect of the present invention is that the wall members include two elongated support members and a cross member fixedly connected between the support members.

Another aspect of the present invention is that the at least one end cap includes two end caps. The plurality of wall members having a first and second receiving member at opposing ends of the wall member. The attachment means of one end cap being received into the receiving members on opposing ends of the wall members and portions of the wall members being received into attachment means of another end cap.

The foregoing objects, advantages and distinctions of the invention, among others, are obtained in a presently preferred construction that provides a truss assembly having a foldable end cap connecting planar wall elements.

These and various other advantages and features of novelty which characterize the invention are pointed out with particularity in the claims annexed hereto and form a part hereof. However, for a better understanding of the invention, its advantages, and the objects obtained by its use, reference should be made to the drawings which form a further part hereof, and to accompanying



descriptive matter, in which there are illustrated and described specific examples of an apparatus in accordance with the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings in which like reference numbers represent corresponding parts throughout:

Fig. 1 illustrates a perspective view of a foldable end cap according to an embodiment of the present invention;

Fig. 2 illustrates an exploded view of a foldable end cap as shown in Fig. 1 according to an embodiment of the present invention;

Fig. 3 illustrates a perspective view of a foldable end cap as shown in Fig. 1 in a completely folded configuration according to an embodiment of the present invention;

Fig. 3A illustrates a perspective view of a foldable end cap as shown in Fig. 1 with accompanying bracing elements according to an embodiment of the present invention;

Fig. 4 illustrates a perspective view of a foldable truss assembly according to an embodiment of the present invention;

Fig. 5 illustrates a perspective view of a foldable end cap as shown in Fig. 4 in a completely folded configuration according to an embodiment of the present invention; and

Fig. 6 illustrates an exploded view of a truss member having foldable end caps according to another embodiment of the present invention.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail herein. It is to be understood, however, that the

intention is not to limit the invention to the particular embodiments described. On the contrary, the invention is intended to cover all modifications, equivalents, and alternatives falling within the scope of the invention as defined by the claims appended hereto.

## DETAILED DESCRIPTION OF THE VARIOUS EMBODIMENTS

In the following description of the illustrated embodiments, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration, various embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized, and structural and functional changes may be made without departing from the scope of the present invention.

The present invention provides a portable support structure adapted for use in temporary or permanent stands or displays. The portable truss assembly is provided with a foldable end cap that connects planar wall elements.

Fig. 1 illustrates a perspective view of a foldable end cap according to an embodiment of the present invention. In Fig. 1, a foldable end cap 100 includes a pair of arm members 102 and a pair of end bars 107. The arm members 102 are connected at both ends to adjacent end bars 107 such that the ends of the arm members 102 are pivotally connected to the adjacent end bars 107. In this way, the arm members 102 and end bars 107 are joined to form a closed loop shape (e.g. rectangle, square or variable parallelogram). Hinge brackets 120 are located on both ends of the end bars 107 and interact with corresponding holes in the adjacent arm members 102 to join the arm members 102 to the end bars 107. Attachment members 106 protrude from an interior space 105 of corner members 110 of end bars 107 generally perpendicular to a plane formed by the arm members 102 and the end bars 107. The attachment members 106 may protrude from one or both sides of the corner members 110 as desired. The end

cap 100 has been shown with the arm members 102 and end bars 107 joined in a flush mount end-to-end swiveling configuration. The hinge bracket assembly shown in Fig. 1 may also be replaced with a swiveling mechanism as disclosed below with reference to Fig. 4.

Fig. 2 illustrates an exploded disassembled view of the end cap 200. In Fig. 2, arm members 102 are shown having holes 132 disposed at both ends thereof. End bars 107 are shown having hinge brackets 120 disposed on corner members 110. The hinge brackets 120 have holes 121 for cooperating with holes 132 of the arm members 102. A fastening assembly 125, including nut 124, bolt 126 and washers 122, is inserted through holes 121 in hinge bracket 120 and holes 132 of arm member 102 to secure end bar 107 to arm member 102. The corner members 110 are shown disposed at both ends of the end bars 107. Attachment members 106 are shown disposed in an interior 105 of the corner members 110.

Fig. 3 shows the end cap 300 in the fully folded configuration. In this configuration, the end cap 300 requires minimum storage space and is more easily transport or stored.

The end cap 300A may be further stabilized with bracing elements 150 as illustrated in Fig. 3A. In Fig. 3A, the bracing elements 150 are provided with holes 155 which are adapted to fit over attachment members 106 to secure diagonal corner elements 110 and prevent transverse movement or folding of the end cap 300A.

Fig. 4 illustrates a perspective view of a foldable end cap 400 according to another embodiment of the present invention. In Fig. 4, a foldable end cap 400 includes a pair of arm members 103 and a pair of end bars 108. The arm members 103 are connected at both ends to adjacent end bars 108 such that the ends of the arm members 103 are pivotally connected to the adjacent end bars 108. In this way, the arm members 103 and end bars 108 are joined to form a closed loop shape (e.g. rectangle, square or variable parallelogram). Swiveling mechanisms 140 are located on both ends of the end bars 108 and interact with corresponding adjacent arm members 103 to join the arm members 103 to the end bars 108. The end cap 100 has been shown with the arm members 102 and end bars 107 joined in a flush mount end-to-end swiveling configuration. Attachment members (not shown in Fig. 4) may be inserted into corner members 110 or corner members 110 may be adapted to fit over support members of the truss member.

Fig. 5 shows the end cap 500 having the swiveling mechanisms 140 as shown in Fig. 4 in the fully folded configuration. In this configuration, the end cap 500 requires minimum storage space and is more easily transport or stored.

Fig. 6 illustrates an exploded view of a truss member 600 having foldable end caps according to another embodiment of the present invention. The truss assembly 600 may include end cap 400 (as shown in Fig. 4) and end cap 100 (as shown in Fig. 1) or various combinations of end caps 100, 400. The end caps 100, 400 are adapted to be coupled to a pair of wall members 602. Attaching end caps 100, 400 to both the top and bottom of the wall members 602 creates a

truss assembly 600 capable of supporting vertical loads. The wall members 602 include support beams 604 which are typically formed of an elongated, tubular material. In this example, the support beams 604 are illustrated as square tubes, although other cross sectional shapes (e.g., round, rectangular, triangular, oval, L-shape) may be used. A solid (i.e., non-tubular) support beam 604 may be used as well. The support beams 604 may be fabricated from metal, composite materials, plastic, corrugated cardboard, or other materials as may be desirable.

Cross members 606 are fixedly attached to the support beams 604, typically by welding. A preferred cross member structure includes a wire lace as shown, but cross braces (not shown) may be bolted, welded, or attached with other desirable attaching means. The cross members 606 may be fabricated from metal, composite materials, plastic, corrugated cardboard, or other materials as may be desirable. The support beams 604 may include receiving members 808 (in this embodiment an opening or recess in the end of the support beam 604) adapted for receiving and connecting to the attachment members 106 of the end caps 100. Additionally, locking features (not shown) such as pins, latches, clamps and other devices may be used to positively fix the end caps 100, 400 to the receiving members 608. The end caps 100, 400 may remain attached to the wall members 602 during breakdown and setup of the truss assembly 600, thereby greatly simplifying deployment.

To provide additional stability and safeguard against buckling in special installations with extraordinary loads, a pair of removable cross braces (not shown) may be attached between the wall members 602. It is appreciated that, if

the cross braces are rotatably attached to the support beams 604, then the truss assembly 600, as illustrated in Fig. 6, can still be folded.

The end cap 100, 400 and truss assembly 600 according to the present invention may beneficially be adapted for all manner of structural uses, including those of a temporary or seasonal nature. One such configuration desirable for uses such as commercial displays or point of sale fixtures is described herein in detail. A truss assembly 600 having approximately 12"x12" cross sectional dimensions is preferable in these applications. The end cap 100, 400 is formed from  $\frac{3}{4}$ " to 1" square steel tubing joined at the corner by attachment members 106 formed of round steel pipe sections approximately  $\frac{3}{4}$ " in diameter. The lengths of the side walls 602 can vary from about 6" to about 46". The support members 604 are formed from  $\frac{3}{4}$ " to 1" round steel tubing welded to 3/16" wire lacing forming the cross members 606. While the various sections of the end cap are illustrated as square tubing sections and the truss assembly sections are illustrated as round tubes, other cross sectional shapes (e.g. rectangular, triangular, oval, L-shape) and combinations thereof may be used. The individual sections may be solid, non-tubular or hollow and be fabricated.

Fabricating the truss assembly 600 from steel offers advantages of low cost, high strength, and magnetic properties for easy attachment of magnetic graphics. The steel is typically powder coated for appearance and corrosion resistance. The weight of the truss assembly 600 can range from  $\frac{1}{2}$  pound to 10 lbs for truss lengths between 6" and 46".



In general, the strength of the coupled truss assembly 600 in this application should be able to be safely used in a vertically loaded application where low cost is desired. The open space between wall members 602 can be used for attaching shelving and other accessories, while the wall members 602 maintain flat surfaces that provide strong support and may also be used to attach graphics.

Because the end cap 100, 400 is hinged and capable of swiveling motion at corners thereof, the end cap may remain attached to the truss assembly 600 during assembly and disassembly for storage and shipping or may optional be removed. Leaving the end cap 100, 400 attached speeds up the assembly and disassembly process while removing the end cap increases the number of units that can be stored saving storage space.

The foregoing objects, advantages and distinctions of the invention, among others, are obtained in a presently preferred construction that provides portable support structures for use in temporary or permanent stands or displays, such as trade shows and conventions, and particularly to a portable truss assembly having a foldable end cap connecting planar wall elements.

The foregoing description of the exemplary embodiment of the invention has been present for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not with this detailed description, but rather by the claims appended hereto.